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Article *in* Research quarterly for exercise and sport · June 2013

DOI: 10.1080/02701367.2013.784725 · Source: PubMed

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Published online: 22 May 2013.

To cite this article: Ting Liu & Casey M. Breslin (2013): The Effect of a Picture Activity Schedule on Performance of the MABC-2 for Children With Autism Spectrum Disorder, Research Quarterly for Exercise and Sport, 84:2, 206-212

To link to this article: http://dx.doi.org/10.1080/02701367.2013.784725

Research Quarterly for Exercise and Sport, *84*, 206–212, 2013

ISSN 0270-1367 print/ISSN 2168-3824 online
DOI: 10.1080/02701367.2013.784725

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The Effect of a Picture Activity Schedule on Performance of the MABC–2 for Children With Autism Spectrum Disorder

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Purpose: The purpose of this study was to examine the impact of an assessment protocol utilizing a picture activity schedule on the performance of the Movement Assessment Battery for Children–Second Edition (MABC–2) by children with autism spectrum disorder (ASD). **Method:** Twenty-five children (ages 3–16 years; 20 boys, 5 girls) performed the MABC–2 under two different protocols (i.e., traditional protocol and picture activity schedule protocol). In the traditional protocol condition, each child received detailed verbal descriptions and demonstrations prior to the motor skill performance. During the picture activity schedule protocol, a picture of each task was presented to the children and the verbal instructions were minimized to emphasize visual supports. MABC–2 percentile scores were analyzed using a within-subjects repeated-measures analysis of variance. **Results:** All children were delayed or at risk for delay in both fine and gross motor skill performance during the administration of the traditional protocol. However, when the picture activity schedule protocol was utilized, children showed a significantly higher MABC–2 percentile score (12.4) compared with that of the traditional protocol (1.1), $F(1, 24) = 24.143$, $p < .001$. **Conclusions:** The findings indicated that the picture activity schedule protocol may elicit better motor skill performance on the MABC–2 by children with ASD. We suggest researchers and practitioners incorporate a picture activity schedule into the MABC–2 assessment protocol when examining the fine and gross motor performance of children with ASD.

Keywords: fine motor skills, gross motor skills, visual supports, youth

The Centers for Disease Control and Prevention (CDC) reported that 1 in 88 children in the United States would be diagnosed with autism spectrum disorder (ASD), a 23% increase from the 2009 statistic that 1 in every 110 children would be diagnosed with ASD (CDC, 2012). This neurological disorder of idiopathic etiology manifests in difficulties and deficits in communication and social interaction and the exhibition of repetitive and restrictive stereotypic behaviors (American Psychiatric Association, 2000). The increasing prevalence of ASD has made understanding how to communicate with people with ASD a high priority for teachers and clinicians. Besides the behavioral signs and symptoms of a clinical ASD diagnosis, children with ASD are believed to have a relative strength in processing and interpreting visual information as compared with auditory information (American Psychiatric Association, 2000; Grandin, 1995; National Research Council [NRC], 2001; Tissot & Evans, 2003). As such, teachers and practitioners working with children with ASD are encouraged to limit the amount of auditory instruction

Submitted March 14, 2012; accepted July 26, 2012.

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provided and maximize the use of visual supports during instruction (Bryan & Gast, 2000; Dooley, Wilczenski, & Torem, 2001; Johnston, Nelson, Evans, & Palazolo, 2003; MacDuff, Krantz, & McClannahan, 1993; NRC, 2001; Schneider & Goldstein, 2010; Welton, Vakil, & Carasea, 2004).

Visual supports, such as picture activity schedules, are effective at reducing contextually inappropriate behaviors, increasing time engaged in on-task behaviors, and improving the quantity and quality of social interactions in a variety of settings in children with ASD (Bryan & Gast, 2000; Dooley et al., 2001; Johnston et al., 2003; MacDuff et al., 1993; O'Reilly, Sigafoos, Lancioni, Edrisinha, & Andrews, 2005). These visual supports are theorized to help direct attention to the relevant stimuli in the task by making an abstract task concrete, providing advance visual information on the sequence of the tasks, and organizing the environment in which a task is to be completed (Breslin & Rudisill, 2011). A picture activity schedule, a specific type of visual support, is a visual depiction of activities and behaviors to be completed in a certain order when completing a task (Bryan & Gast, 2000; Welton et al., 2004). Because the picture activity schedule provides information regarding what is supposed to happen next, it can relieve anxiety, reduce the exhibition of problematic behaviors, and increase the amount of time engaged in on-task behavior by children with ASD (Downing & Peckham-Hardin, 2000; O'Reilly et al., 2005; Welton et al., 2004).

Picture activity schedules have been effective in decreasing aggression and self-injurious behaviors and increasing cooperation in classroom settings (Dooley et al., 2001; O'Reilly et al., 2005). Baseline data collection indicated that a 3-year-old child diagnosed with pervasive developmental disorder averaged approximately 13 times more disruptive behaviors than compliant behaviors when transitioning between classroom activities. However, following the implementation of a picture activity schedule, compliant behavior during transition time occurred approximately 10 times more frequently than did disruptive behavior (Dooley et al., 2001). Another study, utilizing a single-subject design, employed a multiple baseline approach that found that the use of a picture activity schedule resulted in a decrease in self-injurious behaviors and an increase in engagement in educational lessons by a 12-year-old boy with ASD (O'Reilly et al., 2005).

Further, Bryan and Gast (2000) found that using a picture activity schedule increased contextually appropriate, on-task behaviors and decreased contextually inappropriate, off-task behaviors by at least 70% in language arts class time by three elementary school-aged children with ASD. New leisure skills can also be taught to youth with ASD using picture activity schedules. MacDuff et al. (1993) found that four boys (aged 9–14 years) with ASD, trained to use a photographic activity schedule to structure their leisure time, increased the percentage of time spent engaged in on-task and on-schedule behavior by more than 90%. Additionally, the percentage of time engaged in on-task and on-schedule behavior remained above 90% even when the order of activities was changed or when novel activities were presented on the schedule.

During the last decade, researchers reported that children with ASD exhibit delays in motor skill development when assessed with traditional motor skill testing batteries (Baranek, Parham, & Bodfish, 2005; Berkeley, Zittel, Pitney, & Nichols, 2001; Breslin & Rudisill, 2011; Green et al., 2002; Jansiewicz et al., 2006; Pan, Tsai, & Chu, 2009; Provost, Lopez, & Heimerl, 2007; Staples & Reid, 2010). Reports in the literature suggest that children with ASD may not understand the instructions provided in traditional motor skill assessments such as the Test of Gross Motor Development-Second Edition (TGMD–2; Ulrich, 2000) and the Movement Assessment Battery for Children-Second Edition (MABC–2; Berkeley et al., 2001; Brown & Lalor, 2009; Green et al., 2002; Staples & Reid, 2010). This potential lack of understanding of the instructions, rather than true motor performance, may impact scores on standardized motor skill assessments.

One study revealed that when participants with ASD were asked to engage in locomotor behaviors such as skipping or galloping during the TGMD–2, participants exhibited a walking or running behavior (Berkeley et al., 2001). Similarly, when asked to throw a ball at a target, participants walked to the target and dropped the ball in front of it. Another study utilizing the TGMD–2 reported that the participants did not understand the differences between tasks on the assessment (i.e., between underhand rolling and overarm throwing), and they required additional individualized instructions or physical assistance to complete the task (Staples & Reid, 2010). When using the MABC–2, some children with ASD struggled to perform the skills included (Green et al., 2002). In the Green et al. (2002) study, 4 of the 11 children with Asperger syndrome who were tested using the MABC–2 performed the items on the test in such a way that their motor skillfulness might have been inaccurate of true capability. One child refused to complete the test items upon request, while another 3 children seemed to disregard the assessment instructions and chose instead to engage in fantasy play or create patterns using pegs. It appears that researchers and practitioners may need to adapt the assessment protocols to acknowledge the difficulty in processing auditory information (as opposed to visual information), which is characteristic of many individuals with ASD, to obtain accurate assessment information.

The MABC–2 is a valid and reliable standardized motor assessment that has been reported in the literature pertaining to ASD (Henderson, Sugden, & Barnett, 2007). However, the *MABC–2 Manual* does not provide information regarding instructions that should be provided to the participants, but rather encourages practitioners to use

whatever approach ensures participant understanding and participation (Brown & Lalor, 2009; Green et al., 2002). There have been no reports in the literature as to what approaches are utilized. Breslin and Rudisill (2011) found that the incorporation of picture task cards could elicit higher gross motor quotient scores on the TGMD–2 by children with ASD. Therefore, the purpose of this study was to examine the effects of a picture activity schedule implemented with the MABC–2 by children with ASD. It was hypothesized that the MABC–2 percentile scores would be higher when a protocol incorporating a picture activity schedule was used as opposed to the traditional MABC–2 protocol as specified by the *MABC–2 Manual.*

METHOD

Participants

Participants were recruited through advertisements and personal contacts from local schools and organizations. Children were included if they had (a) been diagnosed with ASD, (b) the ability to understand and communicate with the examiners, (c) the ability to perform the required fine and gross motor skills, and (d) the ability to follow instructions. Twenty-five children (20 boys, 5 girls) aged between 3 and 16 years old and who had ASD participated in this study. All children were diagnosed by a psychiatrist or a licensed psychologist according to the *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition, Text Revision (American Psychiatric Association, 2000), and all met the inclusion criteria. Nine children had a diagnosis of Asperger syndrome, 10 were diagnosed with autistic disorder, and 6 had a diagnosis of pervasive developmental disorder not otherwise specified (PDD-NOS; see Table 1 for participants' demographic information). Participating parents were informed of their rights and the nature of the task and were asked to sign a consent form prior to their child's participation. In addition, children were given an opportunity to provide written assent if they were aged 8 years or older. The study was approved by the institutional review board of the local university.

TABLE 1
Demographic Information of the Participants on Age Band and Autism Spectrum Disorder

		Autism Spectrum Disorder (n)		
Age Band	n	*Asperger Syndrome*	*Autistic Disorder*	*PDD-NOS*
3–6 years	8	3	3	2
7–10 years	12	5	4	3
11–16 years	5	1	3	1

Note. PDD-NOS = pervasive developmental disorder not otherwise specified.

Instrument

Movement Assessment Battery for Children–Second Edition

The MABC–2 (Henderson et al., 2007) contains a total of eight fine and gross motor tasks for each of the three age bands (3–6 years, 7–10 years, and 11–16 years) in three areas: manual dexterity, ball skills, and static and dynamic balance. The MABC–2 is an evaluative tool that can be used to identify children who are significantly behind their peers in motor skill development. Each task's raw score can be converted to a percentile score to determine a child's motor delays compared to their age-matched norms. The test percentile scores are described as a traffic-light scoring system including a *red zone, amber zone, and green zone*. A percentile score $\leq$ 5th is classified in the *red zone*, indicating a significant movement difficulty; a percentile score between the 5th and 15th is classified in the *amber zone,* indicating at risk for movement difficulty; and a percentile score $>$ 15th is classified in the *green zone*, indicating no movement difficulty detected.

Procedure

The MABC–2 was administered at a local elementary school gym by the primary investigator and research assistants. To ensure the accuracy of the assessment, sessions were videotaped. The MABC–2 was administered two times using two different protocols (i.e., traditional protocol and picture activity schedule protocol). Each child was asked to complete the MABC–2 (for the appropriate age band) once using the traditional protocol and once using the picture activity schedule protocol, 1 week apart. The order of protocols was counterbalanced and randomly assigned to each child to eliminate practice effect.

The primary investigator and research assistants followed the *MABC–2 Manual* when administering the tasks. In the traditional protocol condition, each child received detailed verbal descriptions and demonstrations prior to the motor skill performance. Participants were also provided additional instructions and directions if they did not seem to understand when observed from their practice trials or if requested by the participants. During the picture activity schedule protocol, a picture of each task was presented to the children and the verbal instructions were minimized to emphasize visual supports. For example, children were told to look at the picture, watch the demonstration, and then perform a manual dexterity task, an aiming and catching task, or a balance task. No detailed descriptions or explanations of each task were provided to participants in this protocol. The MABC–2 has eight different tasks for each age band. Therefore, three different picture schedules corresponding with the age bands were created (Figure 1). In each age-band picture activity schedule, all eight tasks were lined up vertically according to the assessment sequences

specified by the appropriate age band. The picture activity schedule was posted on the wall at the child's eye level. Participants were asked to look at the picture schedule prior to their motor performance to become familiar with the order of the tasks. Children were also told that they could look at the picture schedule anytime during the performance. Participants removed one picture at a time and put it in the "finished" pocket upon completion of that task.

A research assistant was trained to administer and evaluate the children's performance for each test item. Both the principal investigator and a research assistant evaluated the children's motor skill performance in all three areas. The assistant was considered trained once 90% agreement with the scores of the principal investigator was achieved (Bauer, Wenner, Dropik, & Wewerka, 2000; Saigal et al., 2005). An interrater reliability test was performed between scores of the principal investigator and the assistant. Percentage of interrater agreement between the principal investigator and the assistant was high (96%).

Data Analysis

Fine and gross motor skill raw scores were converted to percentile scores for each child using the MABC–2 conversion tables. That is, the percentile scores were generated for each area (i.e., manual dexterity, ball skills, static and dynamic balance) and their overall percentile scores (combination of all eight tasks). A 3 (age band) × 3

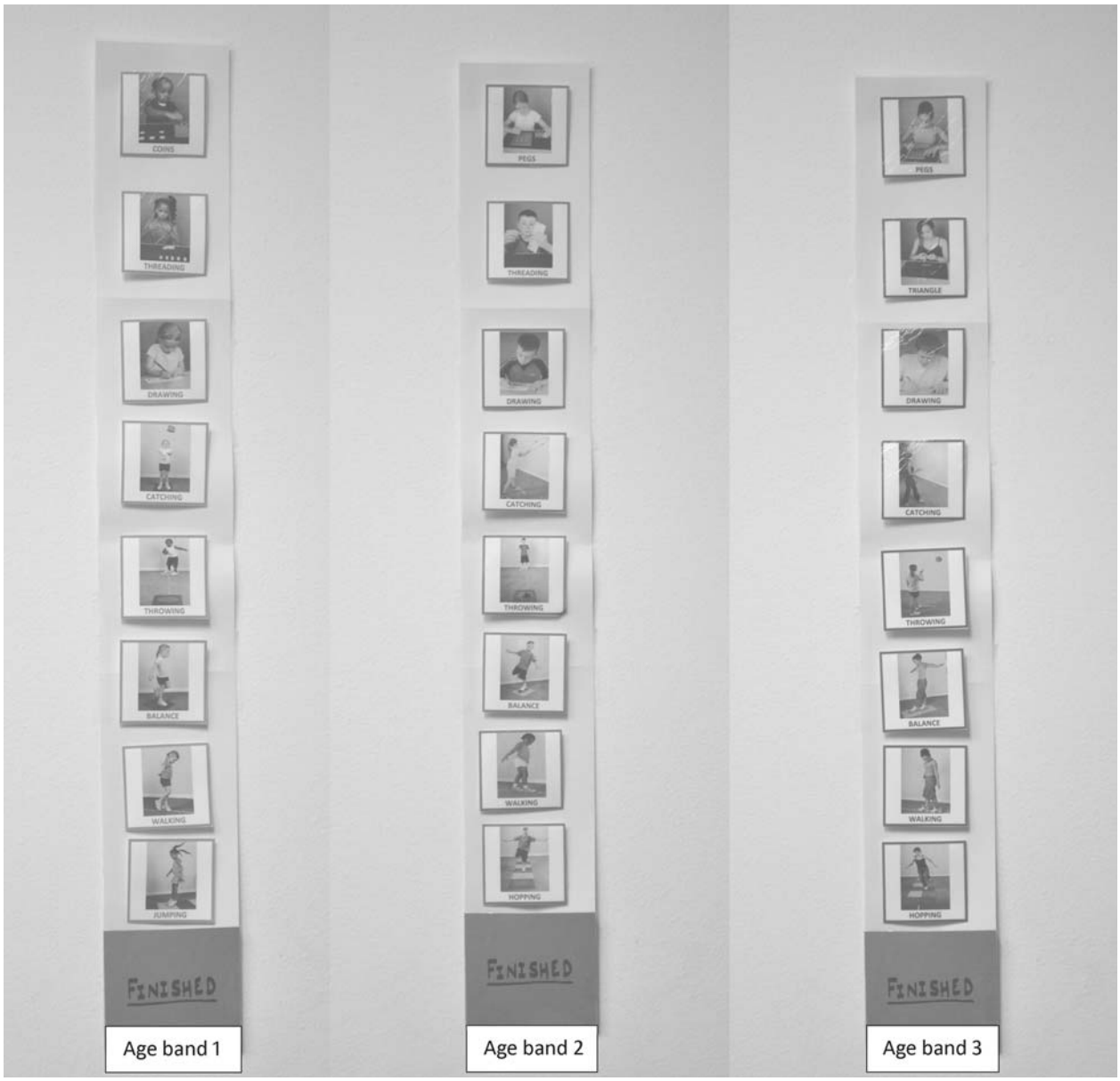

FIGURE 1 Picture activity schedules of three age bands on MABC–2.

(disorder) repeated-measures analysis of variance (ANOVA) was conducted on MABC–2 percentile scores under traditional and picture activity schedule protocols. A chi-square test of independence was calculated comparing the MABC–2 traffic light classification percentages between children in the picture activity schedule protocol and the traditional protocol. Results were considered significant if p values were less than .05. In addition to statistically significant findings, effect sizes (ES) were determined for practical significance using Cohen's d (Cohen, 1988).

RESULTS

A repeated-measures ANOVA on percentile scores (i.e., manual dexterity, ball skills, static and dynamic balance, and overall percentile score) revealed a significant main effect for two protocols, $F(1, 24) = 24.143$, $p < .001$. In addition, a significant interaction between protocols and tasks (i.e., manual dexterity, ball skills, static and dynamic balance, and overall percentile score) was found, $F(3, 22) = 3.187$, $p < .05$. Follow-up ANOVAs for the interaction revealed that children in the picture activity schedule protocol elicited significantly higher percentile scores than those of children in the traditional protocol across all tasks (i.e., manual dexterity, ball skills, static and dynamic balance, and overall percentile score). MABC–2 task item percentile scores by protocol interactions are illustrated in Figure 2. No significant interactions between protocol and age band ($p = .674$) or protocol and disorder were found ($p = .791$). These results suggested that children with ASD benefited from using the picture activity schedule in their MABC–2 performance regardless of age or disorder.

Within the *MABC–2 Manual*, there are traffic light-based charts that indicate if a child is experiencing motor delays, is at risk for motor delays, or is experiencing no motor delays based on their MABC–2 scores (Henderson et al., 2007). A chi-square test of independence showed a significant interaction, $\chi^2(2) = 7.06$, $p < .05$, indicating classification percentages were related to protocol. As evidenced by this traffic-light scoring system, a majority of participants (96%) were delayed or at risk for delay in terms of their motor skill development during the administration of the traditional protocol. When the picture activity schedule protocol was utilized, about 60% of children remained in the red zone and 16% were in the amber zone, indicating they were delayed or at risk for motor delays.

The ES describing motor delays of the study participants between the two protocols were large on manual dexterity (ES = 1.21), ball skills (ES = 0.90), static and dynamic balance (ES = 1.49), and overall percentile score (ES = 1.32). The large ES (>0.80) results were in agreement with the statistically significant findings, indicating that the true effect in the population might be large.

DISCUSSION

The results of this analysis reveal that a picture activity schedule protocol elicited higher MABC–2 percentile scores by children with ASD compared with a traditional protocol. It seems that the incorporation of visual supports and short verbal commands may help children with ASD understand the tasks to be performed during the MABC–2 assessment and may help them, in turn, obtain higher scores. This finding is in agreement with the results of the Breslin and Rudisill (2011) study that visual supports can result in higher scores on motor skill assessments. This provides further evidence suggesting that children with ASD may be better at processing visual information as opposed to auditory information (Grandin, 1995; NRC, 2001; Tissot & Evans, 2003) and that visual supports should be included in assessment as well as in educational settings for children with ASD. Due to the higher percentile scores elicited by the picture activity schedule protocol, it may be beneficial to individuals with ASD to perform motor skill assessments with modifications acknowledging their strengths in visual processing.

Regardless of the task, children with ASD scored higher when provided a picture activity schedule as opposed to the traditional approach utilizing extensive verbal descriptions and physical demonstrations. This finding extends the literature supporting the use of picture activity schedules with children with ASD to improve scores in a motor skills assessment. Picture activity schedules were previously determined to help children with ASD decrease aggressive and self-injurious behaviors and to teach new skills (Bryan

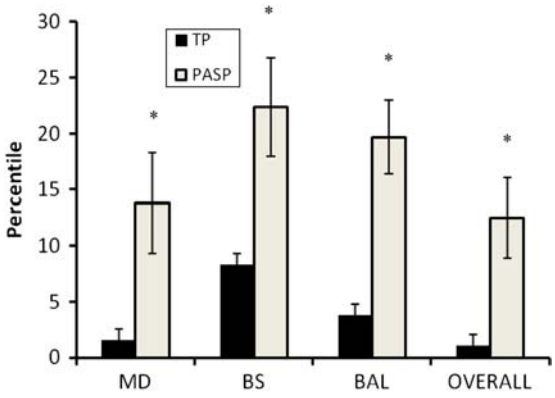

FIGURE 2 Effect of Protocol × Task interaction on MABC–2 percentile scores. The protocol effect was statistically significant (*) across all tasks. Means and standard deviations were plotted for children with ASD in the traditional protocol and the picture activity schedule protocol. *Note*. MD = manual dexterity; BS = ball skills; BAL = static and dynamic balance; TP = traditional protocol; PASP = picture activity schedule protocol.

& Gast, 2000; Dooley et al., 2001; MacDuff et al., 1993; O'Reilly et al., 2005).

The percentile scores of the children with ASD revealed significant motor delays on both fine and gross motor skills, similar to previous findings (e.g., Green et al., 2002; Provost et al., 2007). Participants' weakest scores were in the areas of *manual dexterity* and *static and dynamic balance*, where the mean MABC–2 percentile scores of the children with ASD in the traditional protocol on those tasks were all in the *red zone* (< 5th percentile). Some authors indicated that fine and gross motor delays of children with ASD may be due to imitation impairments and poor motor planning (Charman & Baron-Cohen, 1997; DeMyer, Hingtgen, & Jackson, 1981), difficulty understanding movement goals (Fabbri-Destro, Cattaneo, Boria, & Rizzolatti, 2009; Vernazza-Martin et al., 2005), or deficits in perceptual processing (Vanvuchelen, Roeyers, & De Weerdt, 2007), but the results of this study suggested that the motor skill performance of children with ASD could also be affected by the assessment protocol.

Finally, children with ASD across three age bands in this study, whether they have autistic disorder, Asperger syndrome, or PDD-NOS, benefit from the use of a picture activity schedule and the minimization of verbal instructions to convey the requirements of the MABC–2. Regardless of specific diagnosis or age, children with ASD exhibited higher percentile scores on the MABC–2 in the picture activity schedule protocol than in the traditional protocol utilizing detailed verbal instructions and physical demonstrations. This finding provides further support for the notion that individuals with ASD have a relative strength in visual processing as opposed to auditory processing (American Psychiatric Association, 2000; Grandin, 1995; NRC, 2001).

One limitation of this study is that information was not collected on the level of cognitive or communicative function, so it is possible that some children with ASD may not benefit as much from the picture activity schedule protocol as would children with different levels of autistic disorder. Information was also not collected regarding the medication consumption of participants. Certain medications commonly prescribed to individuals with ASD may influence motor skill performance; however, this effect should be consistent across protocols. When replicating this study, future researchers should include information on children's cognitive function.

In summary, researchers and practitioners should incorporate a picture activity schedule into the MABC–2 assessment protocol when examining the performance of children with ASD. Doing so will potentially capitalize on these children's strengths in processing visual information (as opposed to auditory information) and may result in more accurate evaluation of a child's true motor skill proficiency because children with ASD have difficulty with perceptual processing and understanding movement goals. Therefore, it is recommended that researchers and practitioners provide visual guidance when assessing and teaching motor skills to children with ASD.

WHAT DOES THIS ARTICLE ADD?

The outcomes of this study suggest that using a picture activity schedule can improve the motor skill performance of children with ASD on the MABC–2. This is important because learners placed in educational experiences that are not appropriate to their true skill levels are more likely to engage in contextually inappropriate behaviors. Motor skillfulness is a key factor in successful participation of physical activities, sports, and activities of daily living. A child's ability to move effectively in space in childhood is essential to future complex motor skill development. In addition, children's ability to perform fine and gross motor skills may affect their sport skills, social skills, and communication skills in physical education classes and on the playground. Providing visual supports to children with ASD in both educational and assessment settings can assist them in successfully performing fine and gross motor skills and can motivate them to engage in physical activity and sport-related social activities.

ACKNOWLEDGMENTS

We thank the editor-in-chief, the associate editor, and the two anonymous reviewers for their insightful comments and suggestions on the initial draft of the manuscript. We would also like to acknowledge all the children who participated in this study.

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